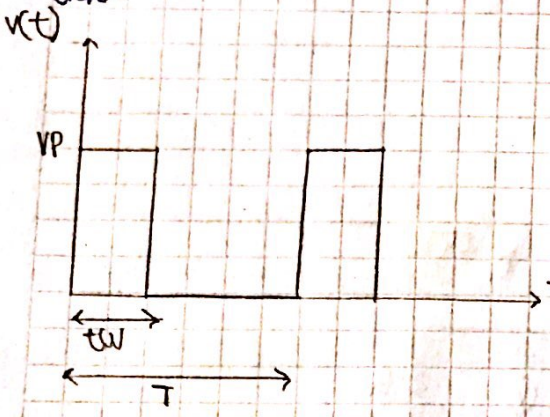
Laboratorio

sabiendo que una onda cuadrada unipolar es medida con un voltímetro en DC obteniendo un valor de 2,15V y midiendo en la función TRUE RMS se obtiene 4,33V, determine el valor del ciclo de AC



$$\overline{V} = \frac{\text{Area } v(t)}{T}$$

$$V_{RMS} = \sqrt{\frac{\text{Area } v(t)^2}{T}}$$

$$\delta = \frac{tw}{T}$$

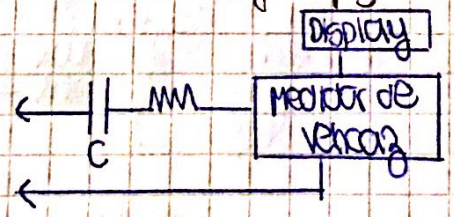
$$\overline{V} = \frac{VP \cdot tw}{T} = VP\,\delta$$

$$V_{RMS\,(AC+DC)} = \sqrt{\frac{1}{T}\int_0^{tw} VP^2} = VP\sqrt{\frac{tw}{T}} = VP\sqrt{\delta} \longrightarrow \text{yo tengo como dato } V_{RMS\,(AC)}$$

$$\text{ref} = \sqrt{\frac{1}{T}\int_{to}^{to+T} v^2(t)\,dt}$$

$$V_{RMS\,(AC+DC)} = \sqrt{V_{RMS\,(AC)}^2 + \overline{V}^2} \quad \text{y despejo.}$$

Mi forma: $V_{RMS\,AC}$



$$V_{RMS\,AC} = \sqrt{\frac{1}{T}\int_0^{tw} (VP - VP\delta)^2} = VP(1-\delta)\sqrt{\delta}$$

$$\Rightarrow \quad 2{,}15V = VP\,\delta \Longrightarrow VP = 2{,}15V \,/\, \delta$$

$$4{,}33V = VP(1-\delta)\sqrt{\delta}$$

$$4{,}33V = \frac{2{,}15V}{\delta}(1-\delta)\sqrt{\delta}$$

$$1{,}732\,\delta = (1-\delta)\sqrt{\delta} \Rightarrow \text{si } \mu = \sqrt{\delta}$$

$$1{,}732\mu^2 = (1-\mu^2)\mu$$

$$\mu^3 + 1{,}732\mu^2 - \mu = 0$$

$$\mu(\mu^2 + 1{,}732\mu - 1) = 0$$

$\mu_1 = 0$ ✗

$\mu_2 = 0{,}4568 \Longrightarrow \delta = \mu^2$

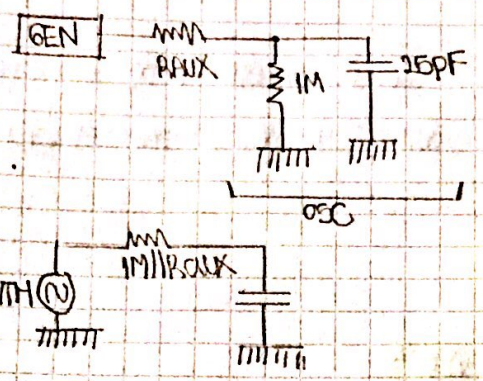
$\mu_3 = -2{,}2$ ✗

$\boxed{\delta = 0{,}21}$

Scanned with CamScanner

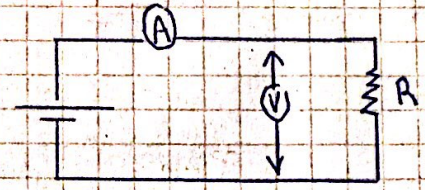
2) ¿Como medirá la capacitancia de entrada del osciloscopio?

Rpta:



3) Se desea medir la resistencia R con el siguiente circuito y datos

	Amp	Volt
clase	1	1
Alcance	100 mA	100V
Ndiv	100	50



La resistencia del Amperímetro y la del voltímetro muy elevada

Determine si es posible medir la resistencia con una incertidumbre ≤ 5% y si fuera posible en que condiciones

Voltímetro

$$\varepsilon_i = \varepsilon_c \cdot \frac{V_{alcance}}{V_{medido}} = 1\% \cdot \frac{100V}{50V} = 2\%$$

$$\varepsilon_a = \frac{1}{4} \cdot \frac{1}{N_{divisiones}} = \frac{1}{4} \cdot \frac{1}{\frac{50V}{\frac{100V}{50}}} = 1\%$$

$$\Rightarrow \varepsilon_V = 1\% + 2\% = 3\%$$

$$\left.\begin{array}{l} 100V - 500V \\ 50V - X = 250V \end{array}\right\}$$

Amperímetro

$$\varepsilon_i = 1\% \cdot \frac{100mA}{I} \qquad K = \frac{100mA}{100V} = 1mA/10V$$

$$\varepsilon_a = \frac{1}{4} \cdot \frac{1}{\frac{i}{\frac{100mA}{100}}} = \frac{1}{4} \cdot \frac{1}{i/1mA}$$

$$\varepsilon_a = 1\% \cdot \frac{100mA}{i} + \frac{1}{4} \cdot \frac{1}{i/1mA} \Rightarrow \frac{1mA}{i} + \frac{0,25}{i/1mA} \leq 0,02 \quad *$$

$$\varepsilon_T = \varepsilon_a + \varepsilon_V = \varepsilon_a + 3\% \leq 5\% \Rightarrow \varepsilon_a \leq 2\%$$

$$\Rightarrow \frac{1 + 0,25}{i/1mA} \leq 0,02 \qquad i_{min} = 62,5mA \qquad \text{Luego } i_{max} = 100mA$$

$$\frac{i}{mA} \geq \frac{1 + 0,25}{0,02} \qquad i \geq 62,5mA \Rightarrow R_{max} = \frac{50V}{0,0625A} \qquad R_{min} = \frac{50V}{0,1A}$$

$$R_{max} = 800\Omega \qquad R_{min} = 500\Omega$$

NOTA

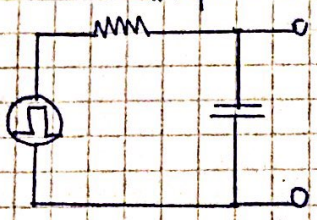
Scanned with CamScanner

FECHA

Es posible para $500\Omega \leq R \leq 800\Omega$

4) se mide el tiempo de crecimiento del circuito indicado, con un osciloscopio de las características dadas. El tiempo observado en la pantalla es 13 nS.

a) determine el tiempo de crecimiento del circuito



BW = 50 MHz

Punta atenuada

t_r punta/osc = 3,5 nS

b) Error sistemático medición

a) $t_{obs}^2 = t_g^2 + t_{prosc}^2 + t_{BW(osc)}^2$

$t_{BW(osc)} = \frac{0,35}{BW}$ $\quad t_{BW(osc)} = \frac{0,35}{50 \cdot 10^6 Hz} = 7nS$

$t_g = \sqrt{t_{obs}^2 - t_{prosc}^2 - t_{BW}^2} \Rightarrow t_g = \sqrt{(13nS)^2 - (3,5nS)^2 - (7nS)^2}$

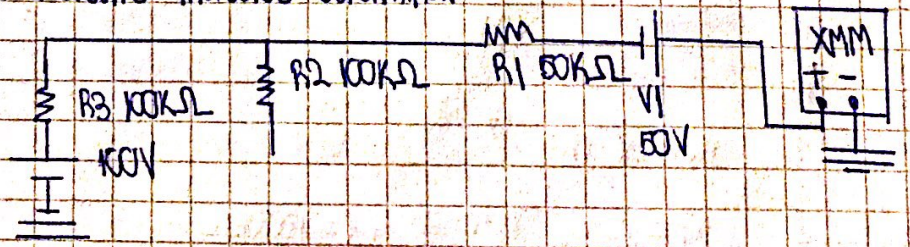
$\boxed{t_g = 10,4nS}$

b) $Esist = \frac{|t_g - t_{obs}|}{t_g}$

$Esist = \frac{10,4nS - 3,5nS}{10,4nS} = \underline{66\%}$

Final 4/8/2014

1) Para el circuito indicado determinar:



a) valor indicado por un IBM onda completa en AC

b) valor indicado por un DVM media onda en AC

IBM: 100 c/V
SV: 15 KΩ/V

Alcances: 5-10-50-100 V
EC: 3%

Incertidumbres de clase: 2%
DVM $\Delta V = 0,5\%$ rdg + 2dg
4 3/4 dígitos

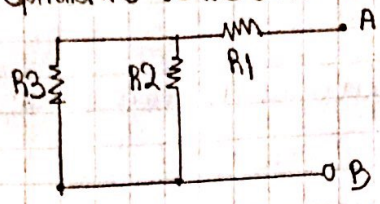
Despreciable apreciación en IBM

NOTA

Scanned with CamScanner

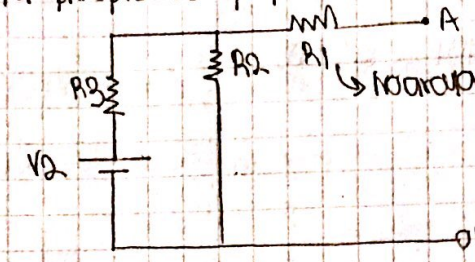
Hallo circuito equivalente de Thevenin

RTH



$R_{TH} = R_1 + R_2 \| R_3 = 50K\Omega + \frac{100K\Omega \cdot 100K\Omega}{200K\Omega} = 100K\Omega$

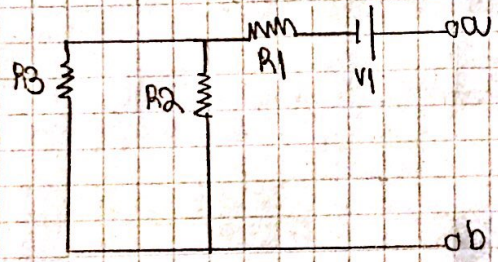
VTH Por principio de superposicion.



BoA

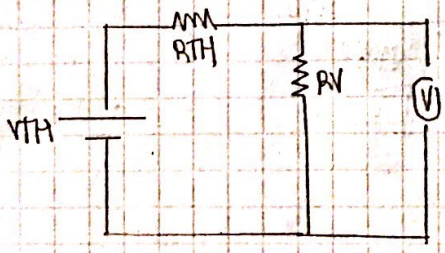
↳ no circula corriente

$V_{ab2} = \frac{R_2}{R_2+R_3} \cdot V_2 \Rightarrow V_{ab2} = 1/2 \cdot V_2 = 50V$



$V_{ab1} = V_1$

$V_{TH} = V_1 + 50V = 100V$



$V = \frac{R_V}{R_{TH}+R_V} V_{TH}$

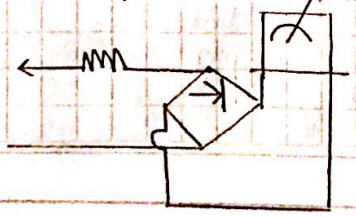
$R_V = 5V \cdot V_{FE}$ ↗ ejo alcance de 100V

$R_V = \frac{15K\Omega}{V} \cdot 100V \Rightarrow R_V = 1500K\Omega$

$\Rightarrow V = \frac{1500K\Omega}{100K\Omega + 1500K\Omega} \cdot 100V$

$\boxed{V = 93{,}75V}$

a) (IBM cada completa en AC, VMR 1:11



↳ $V = 93{,}75V \cdot 1{,}11 = 104{,}06V$

$\Delta V = 3\% \cdot \frac{100V}{93{,}75V} = 0{,}032V$

$\Delta V = 3\% \cdot 100V = 3V$

NOTA

Scanned with CamScanner

b) 0V.

a) DVM DC

4,000V ± 0,03V

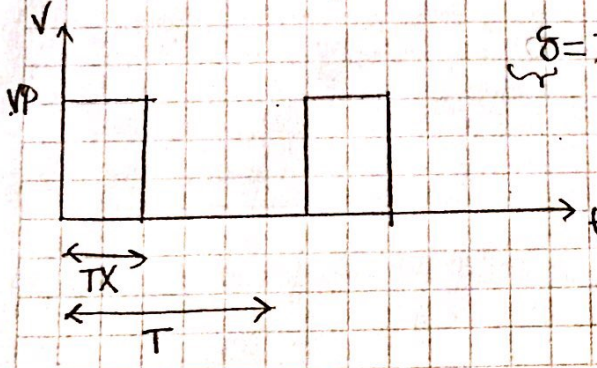
display → medidor de Vmedio

TRUE RMS (AC+DC)

8,194V ± 0,06V

display → medidor de Vefectivo

onda cuadrada unipolar



$$\delta = \frac{TX}{T}$$

$$\sqrt{\delta} = 0,4474$$

$$\sqrt{\delta} =$$

$$Vm = \frac{1}{T} \cdot TX \cdot VP = \delta \cdot VP$$

$$Vef = \sqrt{\frac{1}{T}\int_0^{TX} VP^2 \, dt} = \sqrt{\delta} \cdot VP$$

$$\begin{cases} (1)\ 4V = \delta \cdot VP \\ (2)\ 8,194V = \sqrt{\delta}\, VP \end{cases}$$

$$(1)/(2) \Rightarrow \frac{4V}{8,194V} = \frac{\delta \cdot VP}{\sqrt{\delta} \cdot VP} \Rightarrow \delta = \left(\frac{4V}{8,194V}\right)^2 \Rightarrow \boxed{\delta = 0,2}$$

$$\delta = \left(\frac{VDC}{VAC+DC}\right)^2 \Rightarrow \Delta\delta = \left|\frac{\partial \delta}{\partial VDC}\right| \Delta VDC + \left|\frac{\partial \delta}{\partial VAC+DC}\right| \Delta AC+DC$$

$$\Delta\delta = \frac{2VDC}{(VAC+DC)^2} \Delta VDC + \frac{(VDC)^2}{(VAC+DC)^3} \cdot 2 \cdot \Delta VAC+DC$$

$$\Delta\delta = \frac{2 \cdot 4V}{(8,194V)^2} \cdot 0,03V + \frac{(4V)^2}{(8,194V)^3} \cdot 2 \cdot 0,06V$$

$$\Delta\delta = 5,17 \cdot 10^{-3} \Rightarrow 0,57 \quad (\times 100)$$

$$\boxed{CT = 20,0\% \pm 0,6\%}$$

Scanned with CamScanner

3) $V_p = 2V$
$F = 10Hz$ $T = 0,1S$
superpuesta continua 2V

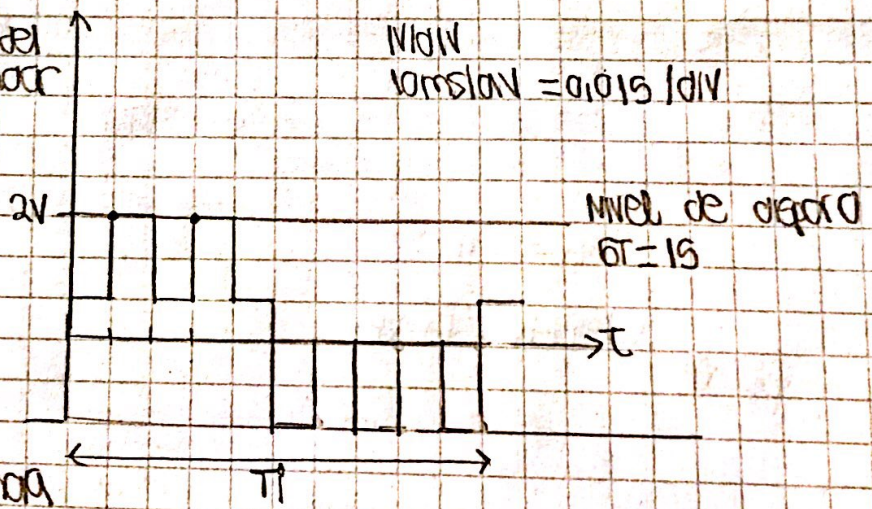
Acoplamiento canal vertical AC

Disparo automatico

Escala vertical 1V/div

Base de tiempo 10ms/div

4)



modo frecuencia

pendiente positiva

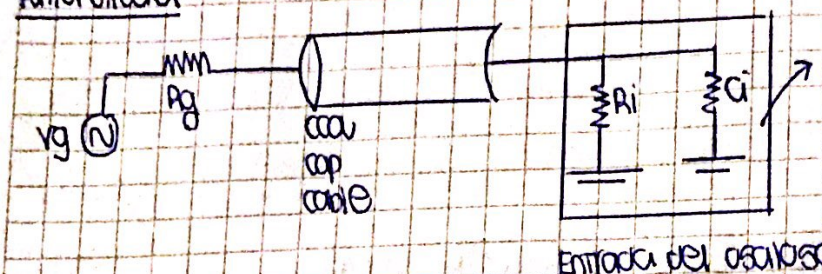
y la pendiente

por el nivel de disparo se cuentan dos pulsos por periodo por lo tanto, como figuran 10 periodos en el timebase el valor indicado por el contador sera de 20.

Scanned with CamScanner

5) Diferencias impedancia entrada de una punta directa respecto de una atenuada

Punta directa



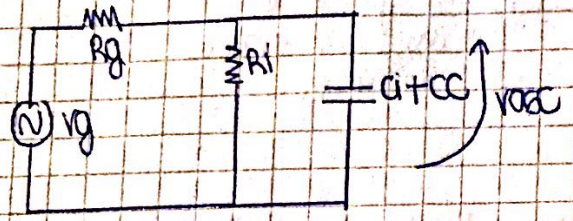
Impedancia entrada = Zi

$Zi = Ri \,//\, Zci$

$|Zi| = \sqrt{Ri^2 + \frac{1}{\omega Ci}}$

Entrada del osciloscopio

↓ circuito equivalente

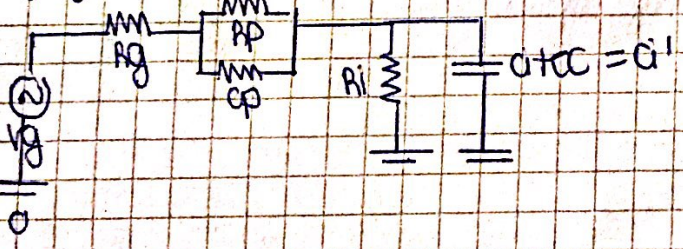


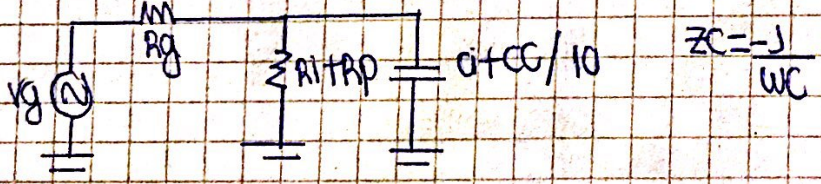
$vosc = vg \frac{(Ri \,//\, XC)}{Ri \,//\, XC + Rg}$

El ancho de banda es del orden de los 6MHz.

Punta atenuada X10

se agrega un capacitor de compensación





$ZC = \frac{-J}{\omega C}$

Impedancia de entrada $Zi = Ri \,//\, Zi' + RP \,//\, ZP$

$Zi = \frac{-Ri\,J}{\omega Ci'} \,//\, \frac{RP\,J}{\omega CP}$

$Zi = \frac{-Ri\,J}{Ri\,\omega Ci' - J} + \frac{RP\,J}{RP\,\omega CP - J}$

$Zi = \frac{-Ri\,J}{Ri\,\omega Ci' - J} \cdot \frac{\omega C}{\omega C} + \frac{RP\,J}{RP\,\omega CP - J} \cdot \frac{\omega CP}{\omega CP}$

$Zi = \frac{-Ri\,J^2}{Ri\,J\omega Ci' + 1} + \frac{RP\,J^2}{RP\,J\omega CP + 1}$

$Zi = \frac{Ri}{Ri\,\omega Ci' + 1} + \frac{RP}{RP\,J\omega CP + 1}$

NOTA

Scanned with CamScanner

Cuando la punta está compensada $R_P C_P = R_i C_i = t$

$$Z_i = \frac{R_i + R_P}{1 + j\omega t}$$

$$Y = \frac{1}{Z_i} = \frac{1}{R_i + R_P} + j\,\frac{\omega t}{R_i + R_P}$$

$$C_{eq} = \frac{\omega t}{R_i + R_P}$$

$$t = C_i' R_i$$

$$C_{eq} = C_i' \cdot \frac{R_i}{R_i + R_P} \Big\} 1/10 \Rightarrow C_{eq} = C_i'/10$$

se reduce 10 veces la capacitancia de entrada

$$R_{eq} = R_i + R_P = 10 R_i$$

se aumenta 10 veces la resistencia de entrada

Punta atenuada

Usar cuando se requiera un osciloscopio de mayor ancho de banda o una señal de una gran amplitud. (frecuencia de corte 10 veces + grande y amplitud 10 veces + chica)

Punta directa

Usar cuando se desee medir señales de muy baja amplitud.

Scanned with CamScanner

24/02/14

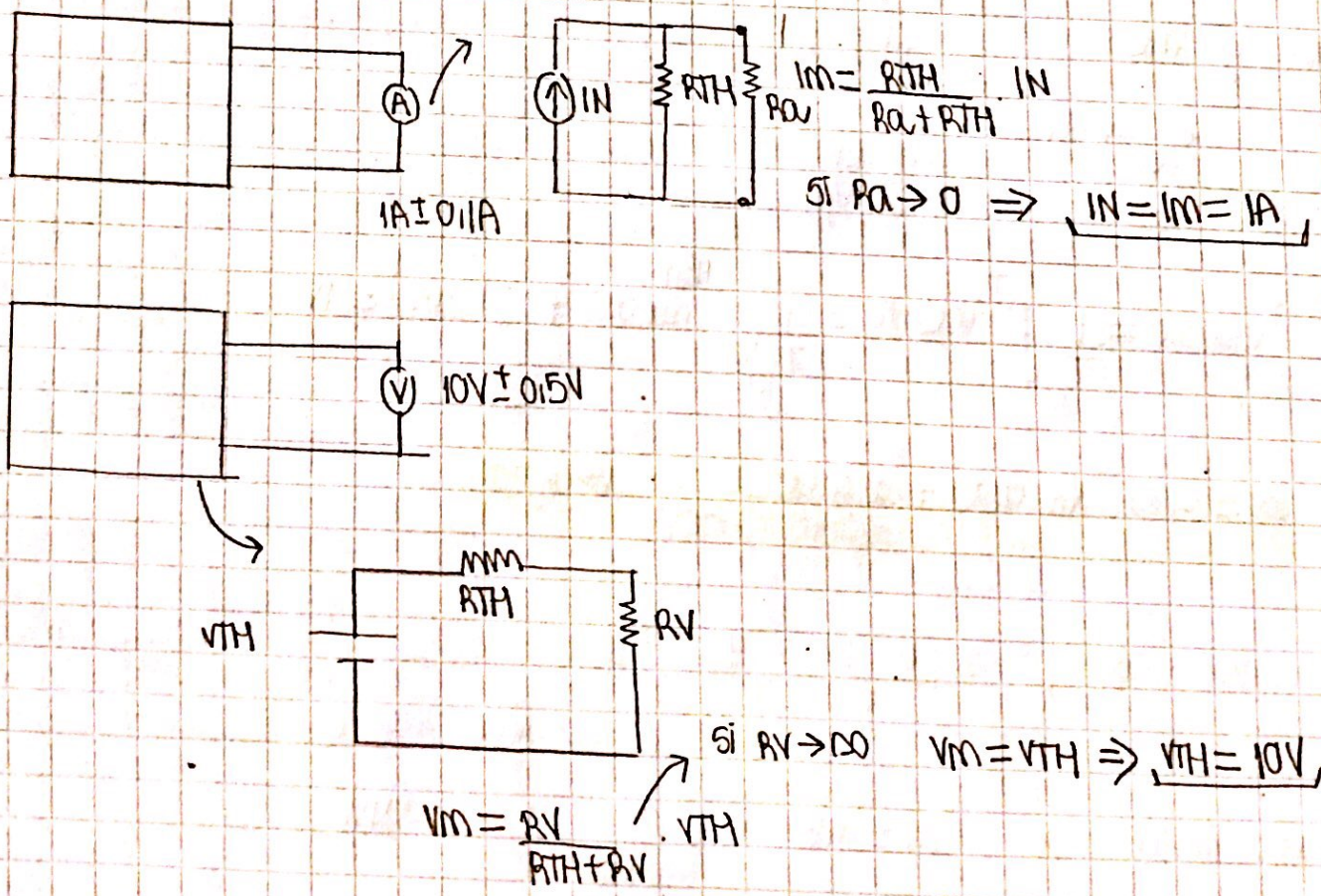
① señal cuadrada 10KHz frecuencia
$t_r = 10ns$

• Mínimo debe tener 3 armónicos de la onda.

$F_{3\,armónicos} = 5 \cdot 10KHz \Rightarrow \boxed{FOSC = 50\,KHz}$

$tcm = \sqrt{tg^2 + tpOSC^2 + tBWOSC^2}$

②

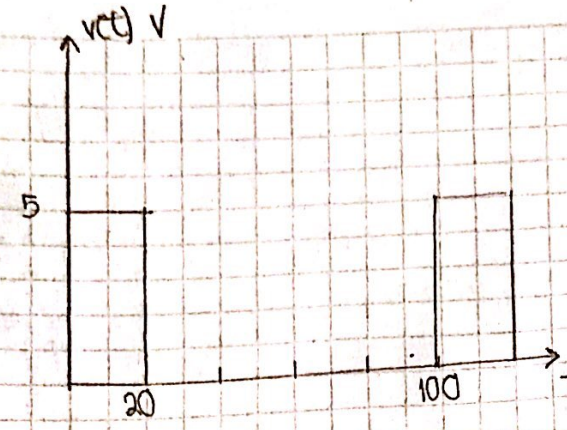


Como $IN = \frac{VTH}{RTH} \Rightarrow RTH = \frac{10V}{1A} = 10\Omega$

$\Delta R =$

Scanned with CamScanner

3)

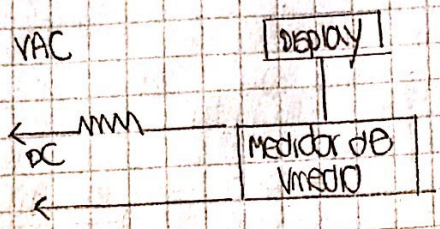


MMD de 3 3/4 dígitos con escalas VDC [± (0,3% + 1)]

VAC [45KHz a 1KHz] [± (1,9% + 2)]

Rent = 10MΩ

a) VDC y VAC



$$V_{medio} = \frac{1}{T}\int_0^T v(t)\,dt = \frac{1}{T}\left(\int_0^{115T} 5\,dt + \int_{115T}^{T} 0\,dt\right) = 1V$$

$$\Delta V = 0{,}3\%\ V_{medido} + \frac{\text{alcance}}{\text{número cuentos}} \cdot \text{nº dígitos}$$

3 3/4 dígitos → | 0..3 | 0..9 | 0..9 | 0..9 |

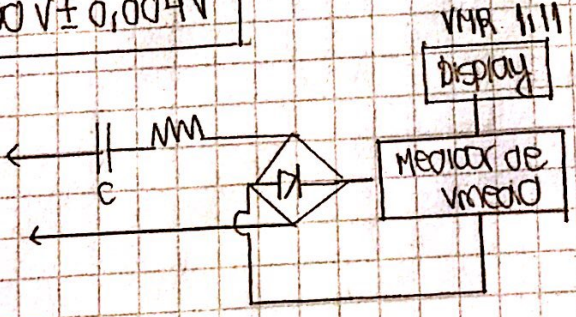
0 0 0 0

3 9 9 9 ⇒ 4000 cuentos

Uso alcance de 4V ⟹ $\Delta V = 0{,}3\%\ 1V + \frac{4V}{4000} \cdot 1 = 0{,}004V$

$V_{DC} = 1{,}000\,V \pm 0{,}004V$

VAC



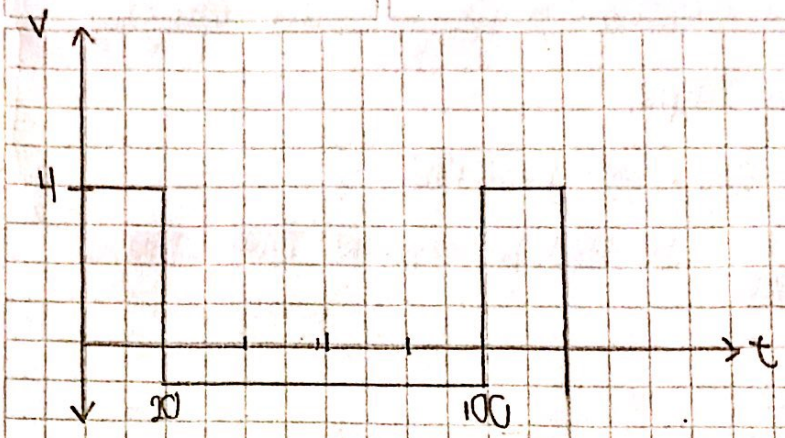
(1) Solo resta el valor medio a la onda

$V_m = 1V$

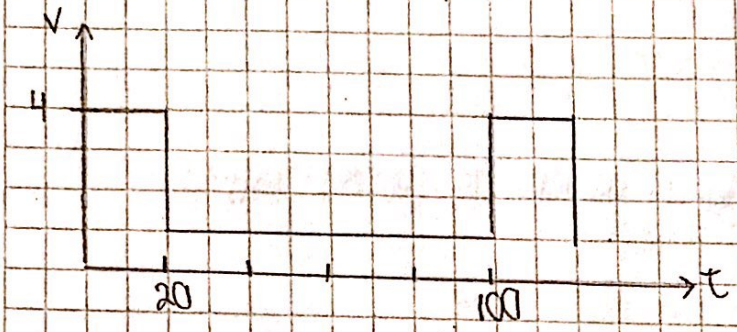
Scanned with CamScanner

HOJA N°

FECHA



② se realiza en onda completa

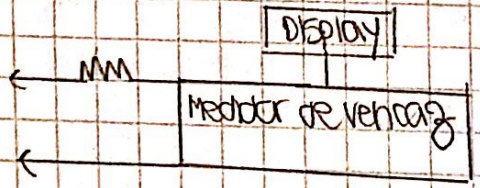


$$V_{mr} = \frac{1}{100}\left(4V \cdot 20 + 1V \cdot 80\right) = 1{,}6V \Longrightarrow \text{display: } \underline{1{,}776V}$$

igual incertezas

$$\boxed{V_{AC} = 1{,}776V \pm 0{,}004V}$$

b) Vef verdadero es AC+DC.



$$V_{ef} = \sqrt{\frac{1}{T}\int_0^T v(t)^2 dt}$$

$$V_{ef} = \sqrt{\frac{1}{T}\left(\int_0^{115T} (5V)^2 dt + 0\right)} = \underline{2{,}236V}$$

igual incertezas

$$\boxed{V_{AC+DC} = 2{,}236V \pm 0{,}004V}$$

Scanned with CamScanner

9) como medir el ciclo de trabajo usando un contador universal

1) conectar el generador al contador (y a un osciloscopio en caso de querer visualizarlo)
2) Poner el contador en modo contador de tiempos
3) Poner el canal 1 con pendiente y el canal 2 con pendiente
4) El valor obtenido es el tiempo del ciclo. Lo divido por el periodo total (obtenido de modo periodo) y lo multiplico por 100.

(4) Factor de cresta = VP/VEF

Uso un voltímetro de valor eficaz verdadero AC+DC con factor de cresta conocido. Al medir el valor eficaz obtengo el valor pico

5) $R_V = 1K\Omega$ $R = 200\Omega$
$R_A = 10\Omega$

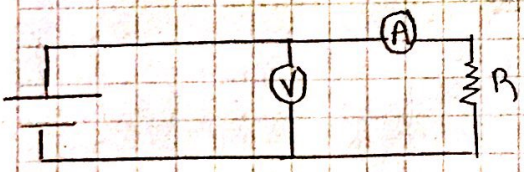
A partir del valor de la resistencia crítica elijo si conviene la conexión larga o corta de voltímetro.

Si $R > R_C$ → conviene la conexión larga

Si $R < R_C$ → conviene la conexión corta

$R_C = \sqrt{R_A R_V}$

$R_C = \sqrt{10\Omega \cdot 1000\Omega}$ $R_C = 100\Omega$ como $R > R_C$:



* como medir el ciclo de trabajo usando un contador universal

- conectar la misma señal en el CHA y en el CHB
- El CHA se coloca con pendiente positiva y el CHB con pendiente negativa
- modo contador de eventos
- se activa cuando el CHA recibe un flanco ascendente y termina cuando el CHB recibe un flanco descendente

Mide el tiempo en alto

- Pones modo periodo y mide el periodo.

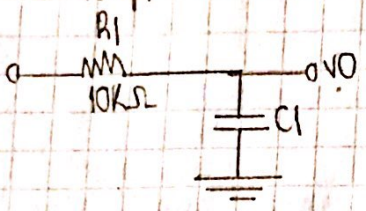
Scanned with CamScanner

A-2-2014

1) osciloscopio analógico

Ancho de banda superior al necesario

C = 100 pF

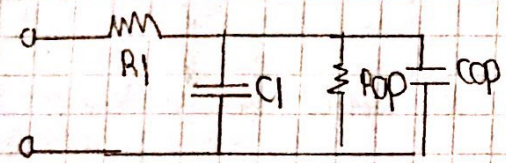


ORC = 25pF

capacitancia cable = 150 pF } Cop = 175 pF ⇒ punta X1

Resistencia = 1MΩ } punta X1

Los datos de la punta X10 se deducen de los de la punta X1



$C_{opX10} = C_{opX1} / 10$ $\quad C_{op} = 17{,}5\,pF$

$R_{opX10} = R_{opX1} \cdot 10$ $\quad R_{op} = 10\,M\Omega$

El generador varía de acuerdo a la interpretación del dato C = 100 pF.

a) C = 100 pF con la carga

$C_{medido} = C_{punta} + C_{real}$

$C_{real} = \underbrace{C_{medido}}_{100pF} - \underbrace{C_{punta}}_{17{,}5\,pF} = 82{,}5\,pF$ $\quad$ Error sistemático $= \frac{C_{medido} - C_{real}}{C_{real}}$

$\varepsilon = 0{,}21$

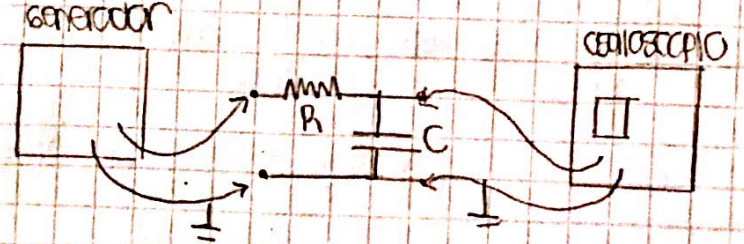
En este caso se usó puntaX10

b) C = 100pF sin la carga. Puedo usar 2 puntas.

$C_{medido} = C_{puntaX1} + C_{real} = 175\,pF + 100\,pF = 275\,pF$ $\quad \varepsilon = 1{,}75$

$C_{medido} = C_{puntaX10} + C_{real} = 17{,}5\,pF + 100\,pF = 117{,}5\,pF$ $\quad \varepsilon = 0{,}175$

Banco de medición

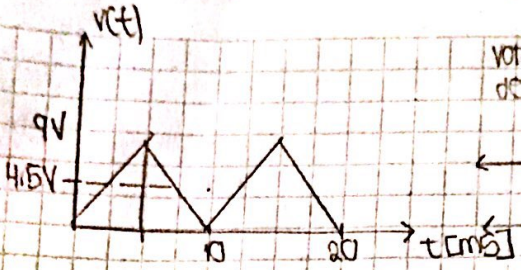


puntaX10 menos efecto de carga.

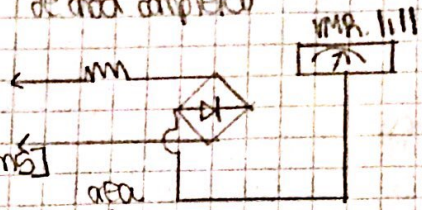
NOTA

Scanned with CamScanner

2)



Voltímetro analógico de valor medio de onda completa



$VMR \cdot 1{,}11 = 5V \Longrightarrow VMR = 4{,}50V \Rightarrow$ área $\frac{VP \cdot 5}{10} \cdot 2 = 4{,}5V$ $\quad VP = 9V$

(10 → período)

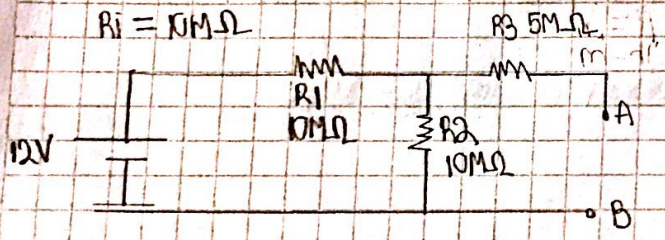
$$VMR_{senoidal} = \frac{VP}{\pi/2}$$

$$VMR_{senoidal} = \frac{9V}{\pi/2} = 5{,}73V \Longrightarrow \text{Se observa } 5{,}73V \cdot 1{,}11 = 6{,}36V$$

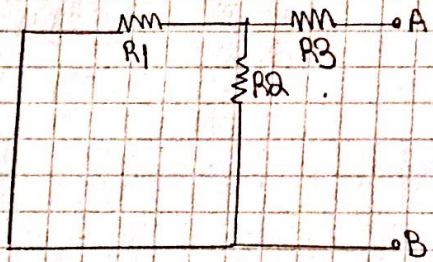
3) Voltímetro digital 3 3/4 dígitos

$\Delta V = \pm (0{,}5\% \cdot \text{lectura} + 2\,dg)$

$R_i = 10M\Omega$



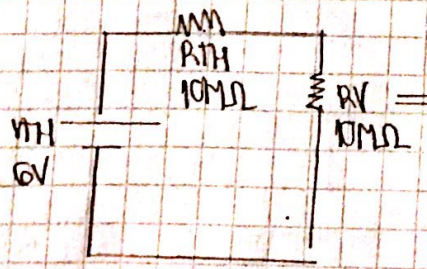
Hallo circuito equivalente de Thevenin:



$R_{TH} = R3 + R1 \| R2$

$R_{TH} = 10M\Omega$

$$V_{TH} = 12V \cdot \frac{R2}{R1+R2} = 6V$$



$$V_m = \frac{RV}{R_{TH}+RV} V_{TH}$$

$V_m = 3V \Rightarrow V = 3{,}000V \pm 0{,}017V$

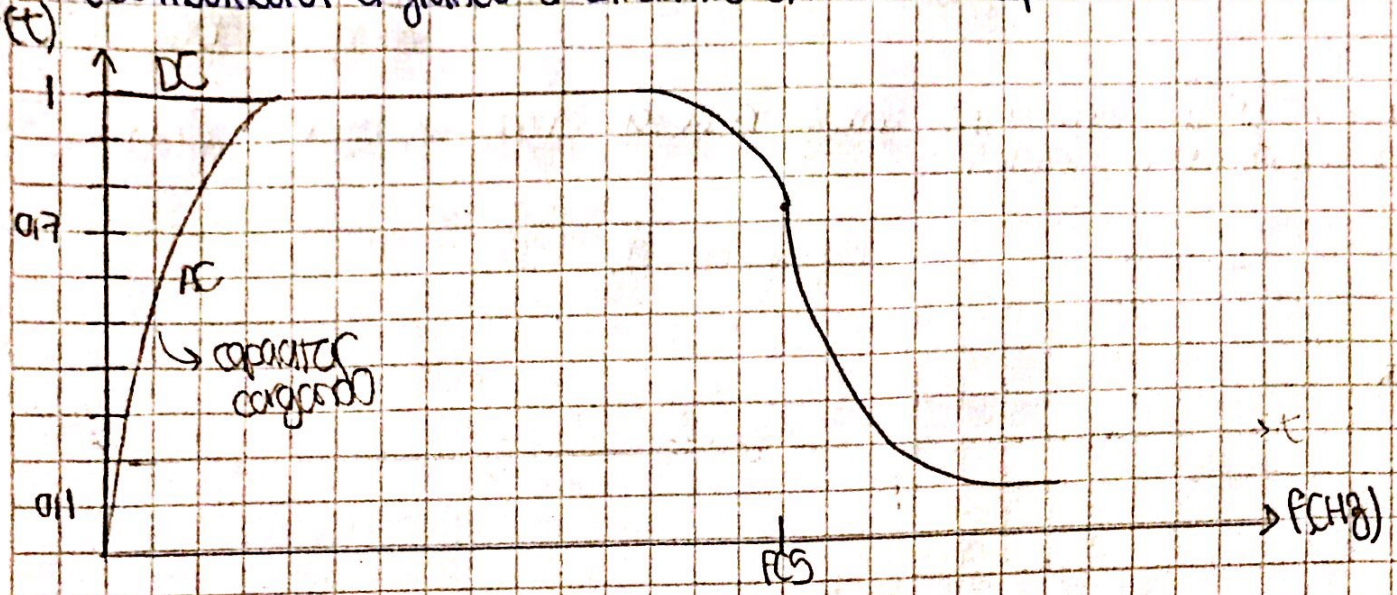
Nº cuentas 0..3 | 0..9 | 0..9 | 0..9 ⇒ 4000 cuentas

Elijo alcance de 4V ⇒ $\Delta V = 0{,}5\% \cdot 3V + 4V/4000 \cdot 2 = 0{,}017V$

Scanned with CamScanner

3) Trace por favor una curva de respuesta en frecuencia de un osciloscopio analógico indicando los ejes y sus escalas. Explique el concepto de frecuencia de corte

¿Se modificará el gráfico si cambiamos el modo de acoplamiento?



El ancho de banda es el rango de frecuencias en las que el osciloscopio puede medir con precisión

Se calcula por convenio desde 0 KHz a la frecuencia de corte en la cual una señal senoidal se visualiza a un 70,7 % del valor aplicado a la entrada (atenuación de 3dB).

Se modifica el gráfico si se cambia el acoplamiento.

4) Incertidumbre = el valor de la semiamplitud de un intervalo alrededor del valor resultante de la medida que se entiende como valor convencionalmente verdadero

Error = diferencia entre valor medido y verdadero

Error sistemático = componente del error que aparece sistemáticamente en sucesivas mediciones de una misma magnitud (en igual condiciones). Se puede corregir o minimizar su efecto

Precisión = medida de la reproducibilidad de las mediciones

Scanned with CamScanner

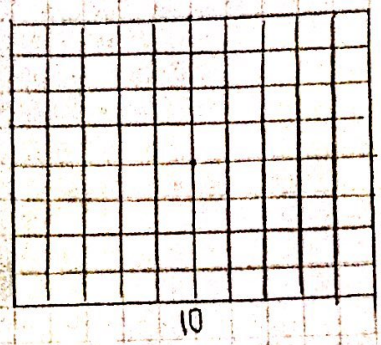
16-12-2013

a) $V_m = 2V$

componente alterna es de 20mV y $f = 50\,Hz \Rightarrow T = 0{,}025$

Tanto para el canal horizontal como para el canal vertical Esc/div = $\frac{10}{\text{divisiones leídas}}$

$\Longrightarrow$ se debería elegir una escala que entregue la mayor cantidad de divisiones posibles y sea observable en la pantalla



Acoplamiento DC

$0{,}025 = 20\,ms \Longrightarrow$ Si elijo escala de 2ms/div entra justo en la pantalla

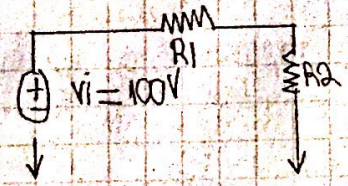
$2V = 2000\,mV$

$20mV = 0{,}02V \Longrightarrow$ Si elijo escala de 1V/div entra justo en la pantalla

b) Igual escala de base de tiempo Acoplamiento GND

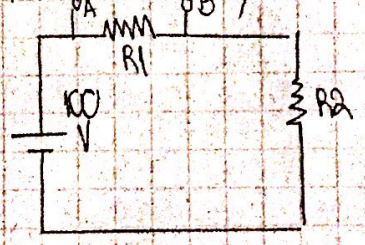
No entra en escala vertical 5V/div es el máximo y tiene componente de valor medio por eso usé acoplamiento AC

a) $R = 10M\Omega$

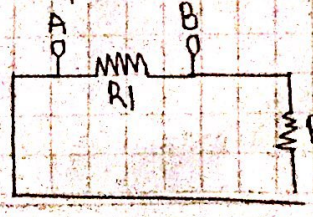


a) $R1 = 200\,K\Omega$
$R2 = 300\,K\Omega$

En los bornes AB cayó el voltaje



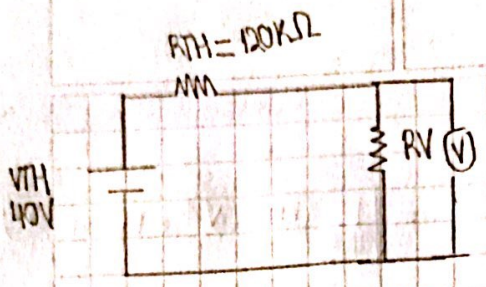
Hallo circuito equivalente de Thevenin



$R_{TH} = R1 // R2 = 120K\Omega$

$V_{TH} = \frac{R1}{R1+R2} \cdot 100V = 40V$

Scanned with CamScanner

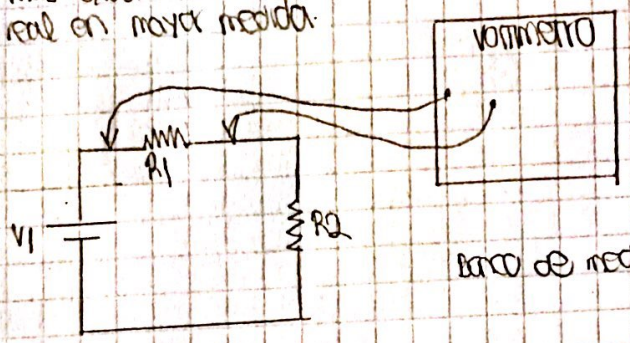


$V_{medido} = \frac{RV}{RTH + RV} VTH$

Si se usa un multimetro digital con una resistencia de entrada de 10MΩ $V_{medido} = 37,5V$

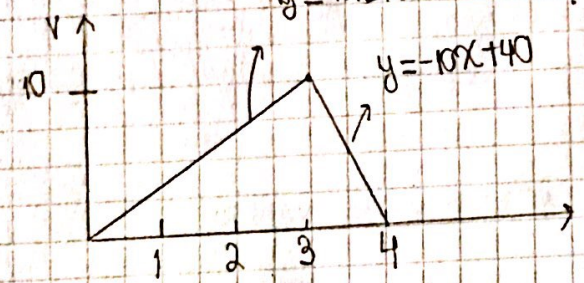
Si se usa un multimetro analogico con una resistencia de entrada de 100KΩ $V_{medido} = 18,2V$

Es mas exacta la medicion con el multimetro digital debido a que se aproxima el valor medido al real en mayor medida.



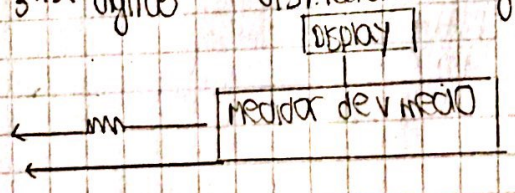
Banco de medicion

3)



a) Multimetro CC digital (DDC)

3 1/2 digitos 0,5% lectura ± 1dg num cuentas 1999 (2000)



$V_{medio} = \frac{10V \cdot 3ms/2 + 10V \cdot 1ms/2}{4ms} = 5V$ uso alcance 20V

$\Delta V = 0,5\% \cdot 5V + \frac{20V}{2000} \cdot 1 = 0,035V$

$V = 05,00V \pm 0,03V$

b) MMD True RMS → Display

← Resistencia de Ref →

$$V_{ef} = \sqrt{\frac{1}{4ms}\left(\int_0^{2ms}\left(\frac{10}{3}x\right)^2 dx + \int_{2ms}^{4ms}(-10x+40)^2 dx\right)} = \sqrt{\frac{1}{4ms}\left(100\,mV^2 + 1013\,mV^2\right)}$$

$V_{ef} = 5{,}77\,V$

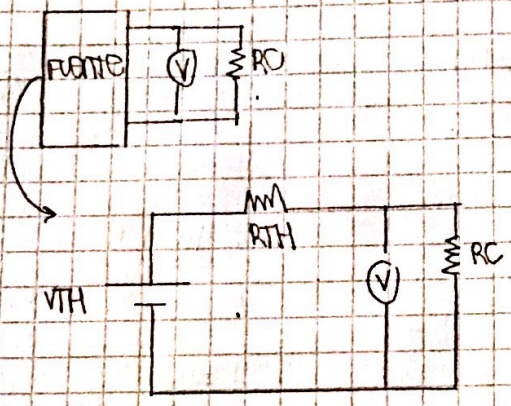
1 9 9 9

$\Delta V = 17.\ 5{,}77V + \frac{20V}{2000}\,2$

$\Delta V = 0{,}0077\,V$

$V_{ef} = 05{,}77\,V \pm 0{,}008V$

b)



$V_{lectura} = \frac{RC}{RTH+RC} \cdot VTH$ VTH y RTH incognitos

① $11V = \frac{1\Omega}{RTH+1\Omega}\,VTH \Longrightarrow VTH = \frac{11V\,(RTH+1\Omega)}{1\Omega}$

② $11{,}5V = \frac{5\Omega}{RTH+5\Omega}\,VTH$

$11{,}5V = \frac{5\Omega}{RTH+5\Omega}\,\frac{11V\,(RTH+1\Omega)}{1\Omega}$

$\frac{23}{22} = 5\,\frac{RTH+1\Omega}{RTH+5\Omega}$

$\frac{23}{110}\left(RTH+5\Omega\right) = RTH+1\Omega$

$0{,}0145\Omega = \frac{87}{110}\,RTH$

$RTH = 0{,}057\Omega \qquad VTH = 11{,}03\Omega$

Scanned with CamScanner

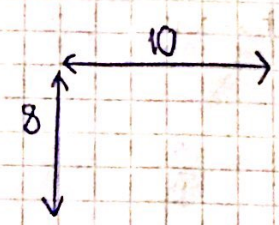
Final 15/12/2014 → lo olvidaré porque no me gustó

1) Escala horizontal

s: 5, 2, 1

ms: 50, 20, 10, 5, 2, 1, 0.5, 0.2, 0.1

μs: 50, 20, 10, 5, 2, 1, 0.5, 0.2, 0.1



Escala vertical

V

mV: 50, 20, 10, 5, 2, 1

V: 5, 2, 1, 0.5, 0.2, 0.1

$Eap = \frac{10}{\text{DIV leídos}}$

↑ DIV leídos ↓ Eap

Medir Vpico a pico 2V
T = 12ms

a) controles

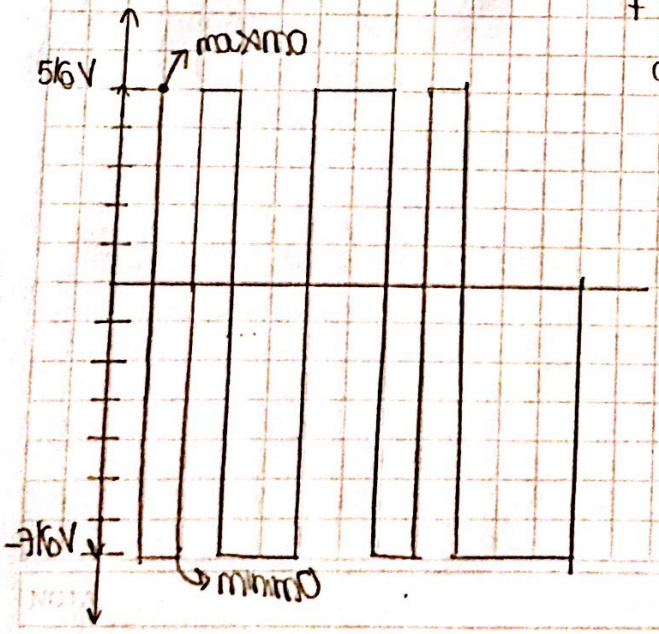
Acoplamiento DC

Disparo automático

0,5V/div escala vertical (4 cuadraditos)

2ms/div (6 cuadraditos)

b) Hallo valor medio: $Vm = \frac{1}{12}\left[\int_0^1 1\sigma + \int_1^2 -1\sigma + \int_2^3 1\sigma + \int_3^5 -1\sigma + \int_5^7 1\sigma + \int_7^8 -1\sigma + \int_8^9 1\sigma + \int_9^{12} -1\sigma\right] = -1{,}6V$



Scanned with CamScanner

20/7/2015

1) $t_{obs} = \sqrt{t_{osc(BW)}^2 + t_{posc}^2 + t_g^2}$ → generador + circuito

$Exist = \frac{|t_g - t_{obs}|}{t_g} \Longrightarrow Exist < 10\%$ $\quad t_g = 30ns = 30 \cdot 10^{-9} s$

$t_{posc} = 10ns = 10 \cdot 10^{-9} s$

$t_{osc(BW)} = \frac{0,35}{BW} \Longrightarrow t_{obs} = \sqrt{\frac{0,35}{BW} + 10^{-15} s^2}$ (2)

$\frac{|30ns - t_{obs}|}{30ns} < 0,1$

$|30ns - t_{obs}| < 3ns$

$t_{obs\,min} = 27ns \Longrightarrow$ no posible por (1)

$t_{obs\,max} = 33ns \Longrightarrow$ posible

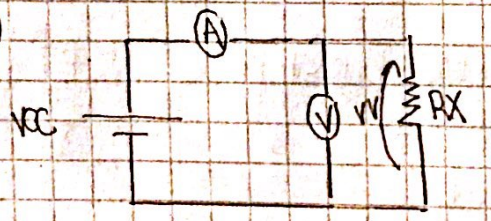
Reemplazo en (2) $33 \cdot 10^{-9} s = \sqrt{\frac{0,35}{BW} + 10^{-15} s^2}$

$1,089 \cdot 10^{-15} s^2 = \left(\frac{0,35}{BW}\right)^2 + 10^{-15} (s)^2$

$8,9 \cdot 10^{-17} s^2 = \frac{0,1225}{BW^2}$

$BW = 370,99925 Hz = 37 MHz$

a)



	VOLT	AMP
BASE	2	1
ALCANCE	100V	100mA
DIVISIONES	100	100

$E_{V\,real} = \frac{1}{4} \frac{1}{N^{o}\,divisiones} = \frac{1}{4} \cdot \frac{1}{100}$

EV

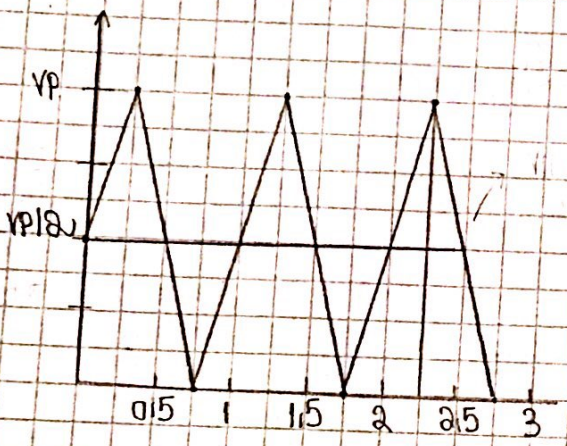
6,6%

Scanned with CamScanner

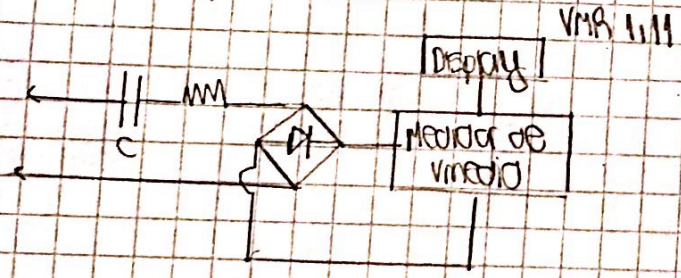
HOJA Nº

FECHA

3)



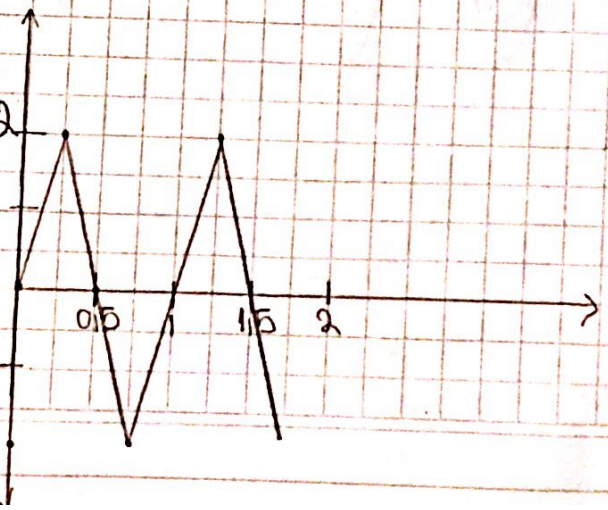
DVM onda completa



$3V = VMR\ 1{,}11 \Rightarrow VMR = 2{,}7V$

$Vm = \frac{\frac{2}{T} VP}{2} = Vp/2$

Le resto a la señal el valor medio Vp/2

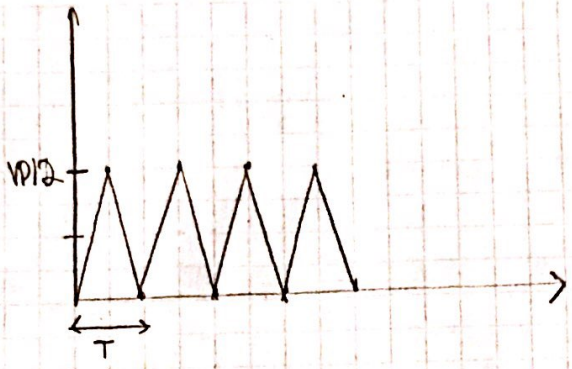


NOTA

Scanned with CamScanner

Rectificó

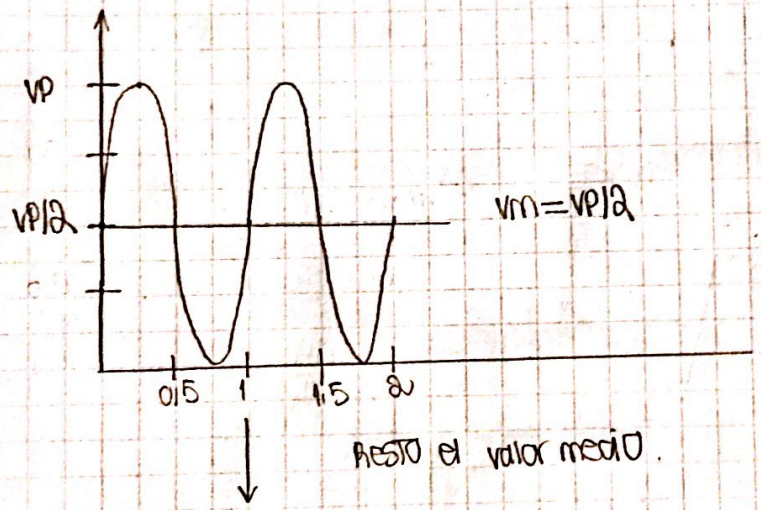
$$V_{MR} = \frac{\frac{V_P}{2} \cdot T}{\frac{2}{T}} = \frac{V_P}{4}$$



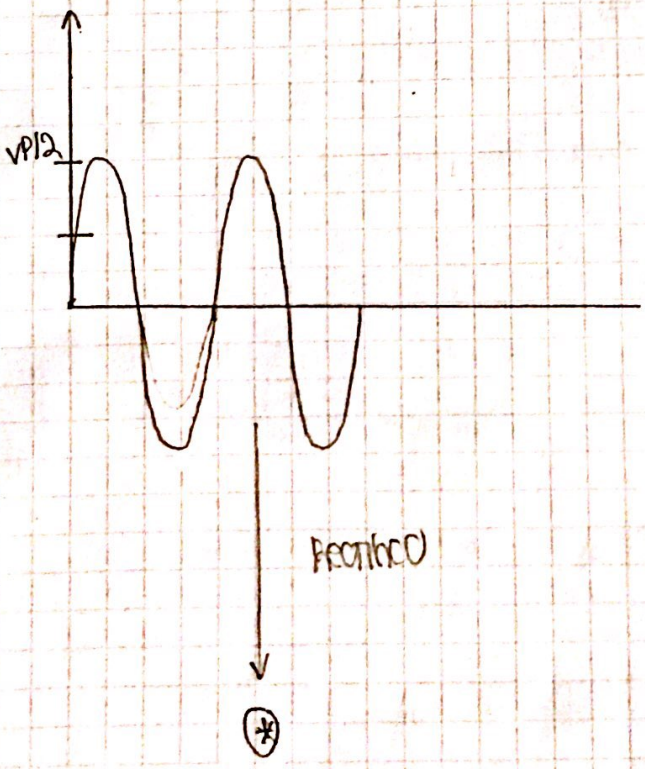
$V_P = 4 V_{MR}$

$\underline{V_P = 10{,}18 V}$

Rectificó la forma de onda.



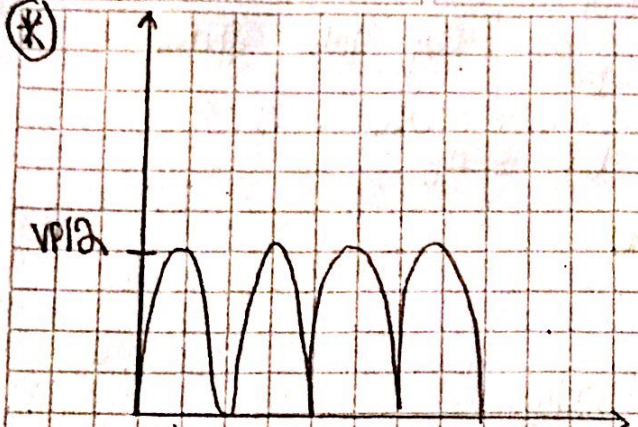
Resto el valor medio.



Scanned with CamScanner

FECHA

(*)

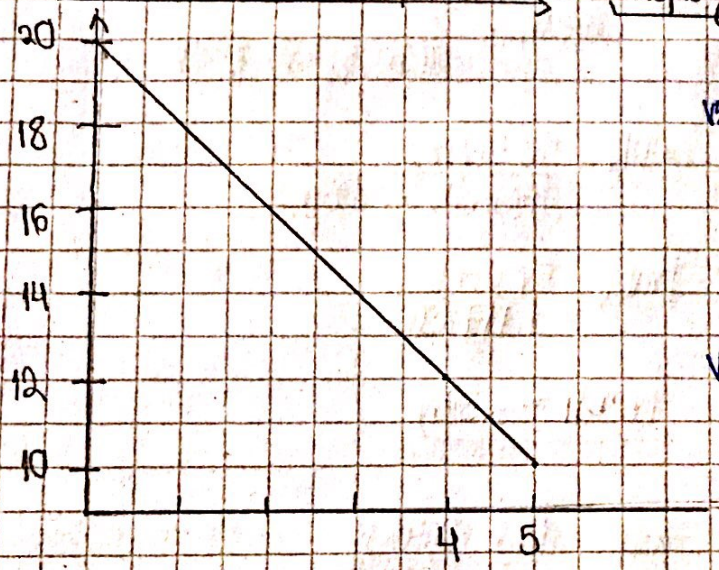


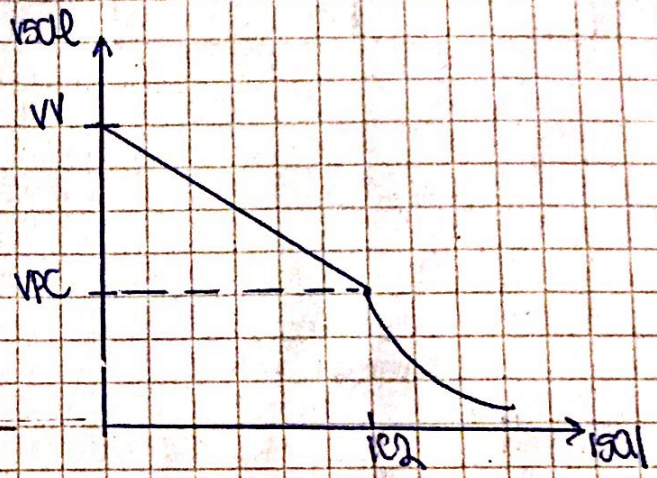
$$rmr = \frac{Vp/8}{\pi/2} = Vp/\pi$$

$$display = Vp/\pi \cdot 1,11$$

$$\underline{display = 3,8V}$$

4)





Regulación de carga

$$n = \frac{VV - VPC}{VV} \cdot 100\%$$

a) $VV = 20V$, $VPC = 12V$

$$n = \frac{20V - 12V}{20V} \cdot 100\% \qquad n = 40\%$$

b) $$RINT = \frac{20V - 12V}{4A} \qquad \underline{RINT = 2\Omega}$$

c) Método diferencial porque arroja menor incertumbre

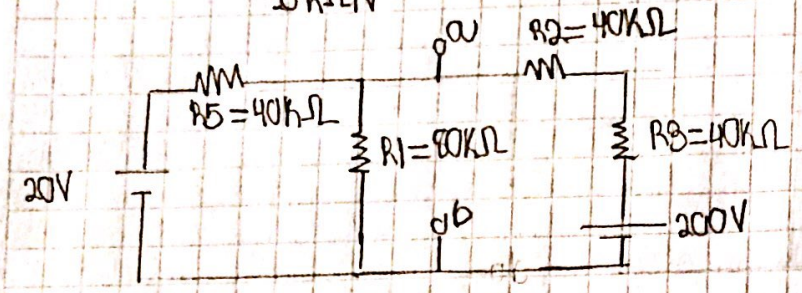
5) Son parámetros independientes?

Scanned with CamScanner

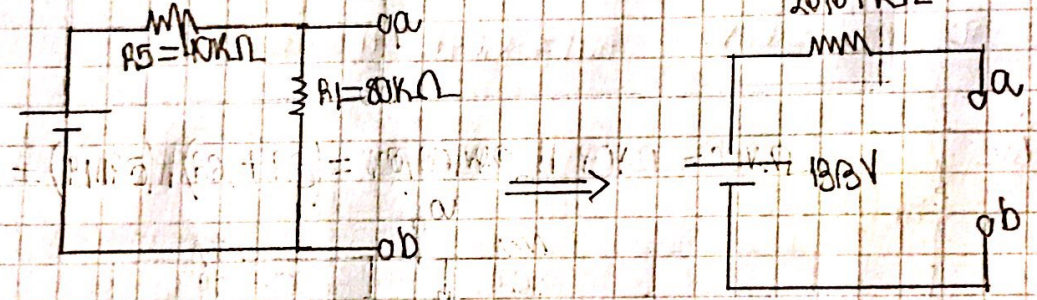
Final 21-07-2014

3) $\varepsilon_c = 3\%$

Alcances: 10V – 50V – 100V
100 divisiones
20 KΩ/V



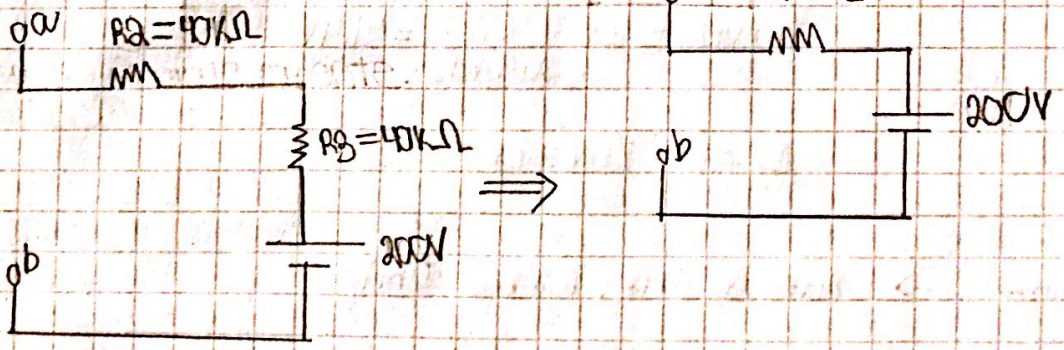
①



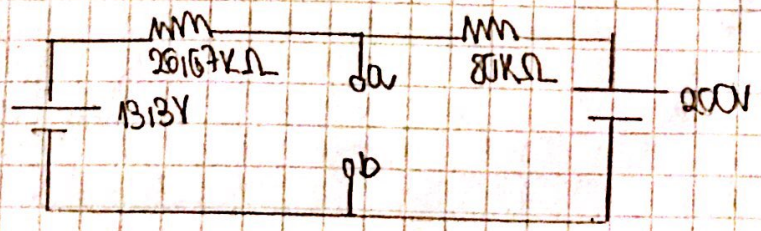
$R_{TH} = R5 \,||\, R1 = 26{,}67\ K\Omega$

$V_{TH} = 20V \cdot \frac{R1}{R1+R5} = 13{,}3V$

②

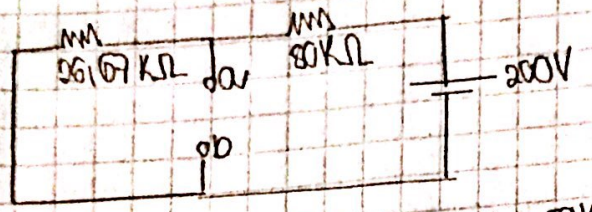


$R_{TH} = R2 + R3 = 80K\Omega$

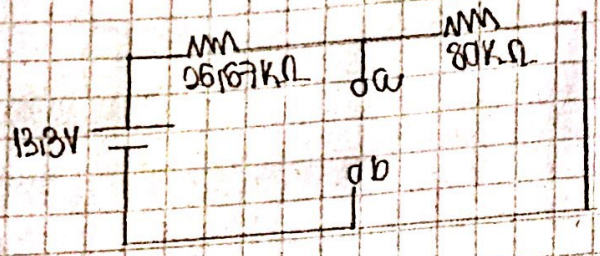


Scanned with CamScanner

Aplico superposición.

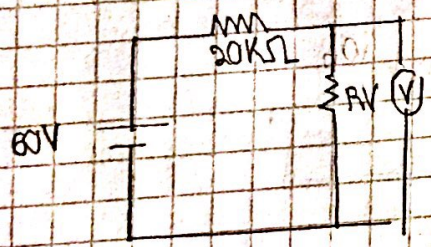


$V_{ab1} = \frac{26,67K\Omega}{26,67K\Omega + 80K\Omega} \cdot 200V = 50V$



$V_{ab2} = \frac{80K\Omega}{80K\Omega + 26,67K\Omega} \cdot 13,3V = 9,97V$

$V_{TH} = V_{ab1} + V_{ab2} = 60V \qquad R_{TH} = 26,67K\Omega \,||\, 80K\Omega$



Tomo alcance de 100V. $V_{FE} = 100V$

$RV = 2000K\Omega$

$V_{medido} = 60V \cdot \frac{2000K\Omega}{2020K\Omega} = 59,4V$

$\Delta V = 3\% \cdot 100V = 3V$

5) $f = 10KHz \longrightarrow$ Ancho de banda mínimo 50KHz

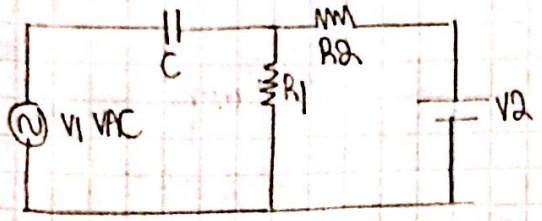
$t_{r\,osc(BW)} = 0,35 / 50KHz = 7 \cdot 10^{-6} s$

$t_{obs} = \sqrt{t_{osc}^2 + t_{posc}^2 + t_g^2}$

Scanned with CamScanner

Final 20-12-12

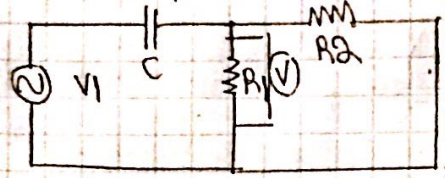
4)



C = 10nF
R1 = 3,9KΩ
R2 = 1KΩ
} Req = R1 // R2 = 0,79KΩ
V1 = 5V pico senoidal
V2 = 15V 20KHz

Como pasó mucho tiempo supongo que salió del transitorio

Aplico método de superposición.

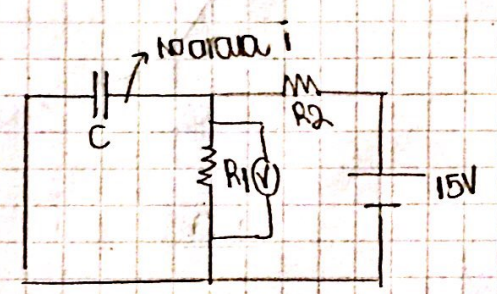


$$|Vab|_1 = \frac{5V \cdot 0,79K\Omega}{0,79K\Omega - \frac{j}{2\pi 20 \cdot 10^3 \cdot 10 \cdot 10^{-9} F}}$$

$$|Vab|_1 = \frac{5V \cdot 0,79K\Omega}{0,79K\Omega - 0,79K\Omega j}$$

$$|Vab|_1 = \frac{5V \cdot 0,79K\Omega}{1,117K\Omega}$$

$$|Vab|_1 = 3,53V$$



$$Vab_2 = 15V \cdot \frac{3,9K\Omega}{4,9K\Omega}$$

$$Vab_2 = 11,938V$$

formula pedida

↳ $V_{RMS\ AC+DC} = \sqrt{12^2 + 3,53^2} = 12,5V$

DVM mide son diferentes

Final 13/7/15

4) $t_{rdos} = 12ns \pm 2ns$

$t_{rp-osc} = 4ns$

$B_W = 100MHz$

$t_g = \sqrt{t_{dos}^2 - t_{prima}^2 - t_{osc}^2}$

$t_g = \sqrt{((12)10^{-9}s)^2 + (4\ 10^{-9}s)^2 - \left(\frac{0,35}{100.10^6}\right)^2}$

$t_g = 12ns$

NOTA

Scanned with CamScanner

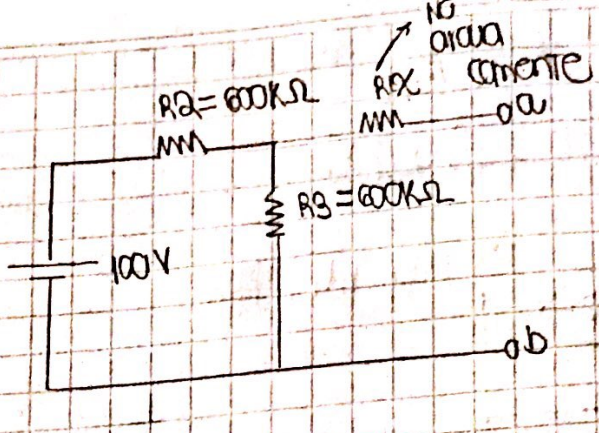
Final 26/12/15

3) $S_V = 20\,K\Omega/V$

Alcances 5 - 50 - 100 - 500 V

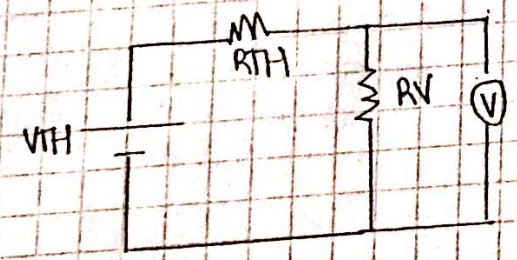
clase 3

100 div



$R_{TH} = R_X + R_2 \| R_3 = R_X + 300\,K\Omega$

$V_{TH} = 100V \frac{600K\Omega}{1200K\Omega} = 50V$



Uso alcance de 100V $\quad R_V = \frac{20K\Omega}{V} \cdot 100V = 2000\,K\Omega$

$\varepsilon = \frac{|V_{TH} - V_m|}{|V_m|} < 10\,\%$ $\qquad V_m = \frac{R_V}{R_{TH} + R_V} V_{TH} = \frac{2000K\Omega}{2300K\Omega + R_X} V_{TH}$

$|V_{TH} - V_m| < 10\,\% \cdot V_{TH}$

$|50V - V_m| < 5V$

$-5V < 50V - V_m < 5V$

$50V - V_m < 5V$

$V_m > 45V$

$\frac{2000K\Omega}{2300K\Omega + R_X} \cdot 50V > 45V$

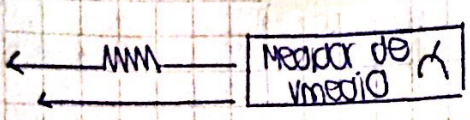
$2000K\Omega > \frac{9}{10}(2300K\Omega$

FEO

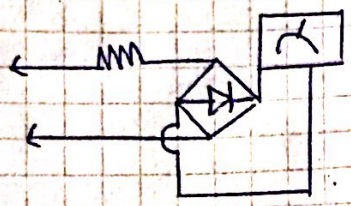
Tipos de voltmetros

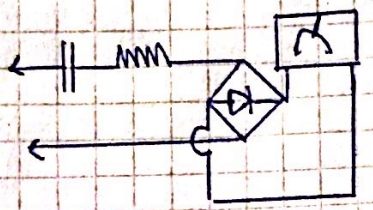
Analógicos

DC



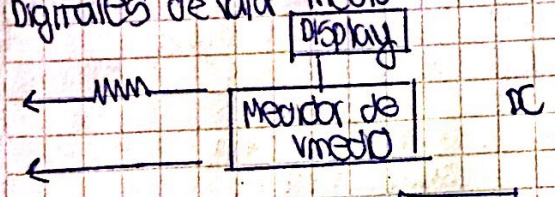
AC

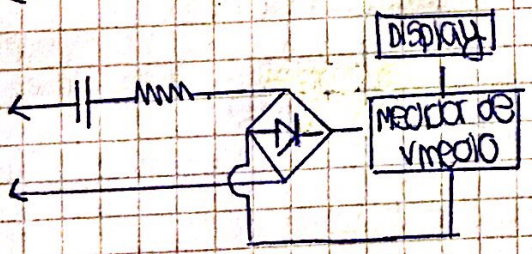




$$\Delta V = \%C \cdot V_{FE} + \frac{1}{4} \cdot \frac{V_{FE}}{NDIV}$$

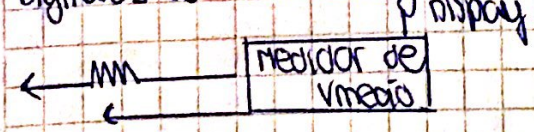
Digitales de valor medio

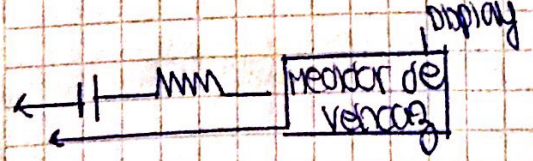


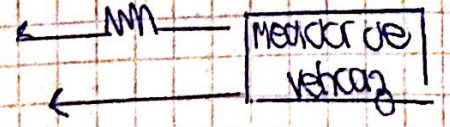


$$\Delta V = \%. \ V_{medido} + \frac{\text{alcance}}{\text{numero de cuentas}} \cdot \text{no digitos}$$

Digitales de valor eficaz







Scanned with CamScanner